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PRIORITY DOCUMENT

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Dated 24th June 1997

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Request for grant of a patent

(See the notes on the back of this form. You can also get an explanatory leaflet from the Patent Office to help you fill in this form)

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Cardiff Road
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1. Your reference — P31659GB

2. Patent application number *(The Patent Office will fill in this part)* — **9611633.0**

3. Full name, address and postcode of the or of each applicant *(underline all surnames)*

PYRONIX LIMITED
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S66 8QY

Patents ADP number *(if you know it)*

If the applicant is a corporate body, give the country/state of its incorporation — UNITED KINGDOM

6537997001

4. Title of the invention — ELECTRONIC CIRCUIT DEVICE

5. Name of your agent *(if you have one)*

HALL, ROBERT LEONARD

"Address for service" in the United Kingdom to which all correspondence should be sent *(including the postcode)*

DIBB LUPTON BROOMHEAD
FOUNTAIN PRECINCT
BALM GREEN
SHEFFIELD, S1 1RZ

Patents ADP number *(if you know it)* — 5617733004

6. If you are declaring priority from one or more earlier patent applications, give the country and the date of filing of the or of each of these earlier applications and *(if you know it)* the or each application number

Country	Priority application number *(if you know it)*	Date of filing *(day / month / year)*

7. If this application is divided or otherwise derived from an earlier UK application, give the number and the filing date of the earlier application

Number of earlier application	Date of filing *(day / month / year)*

8. Is a statement of inventorship and of right to grant of a patent required in support of this request? *(Answer 'Yes' if:*

a) any applicant named in part 3 is not an inventor, or
b) there is an inventor who is not named as an applicant, or
c) any named applicant is a corporate body.
See note (d))

YES

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9. Enter the number of sheets for any of the following items you are filing with this form. Do not count copies of the same document

Continuation sheets of this form	0
Description	12
Claim(s)	5
Abstract	1
Drawing(s)	6

10. If you are also filing any of the following, state how many against each item.

Priority documents	0
Translations of priority documents	0
Statement of inventorship and right to grant of a patent *(Patents Form 7/77)*	0
Request for preliminary examination and search *(Patents Form 9/77)*	1
Request for substantive examination *(Patents Form 10/77)*	0
Any other documents *(please specify)*	0

11. I/We request the grant of a patent on the basis of this application.

Signature [signature] Date 3 JUN 1996

12. Name and daytime telephone number of person to contact in the United Kingdom

R L HALL 0114 283 3253

Warning

After an application for a patent has been filed, the Comptroller of the Patent Office will consider whether publication or communication of the invention should be prohibited or restricted under Section 22 of the Patents Act 1977. You will be informed if it is necessary to prohibit or restrict your invention in this way. Furthermore, if you live in the United Kingdom, Section 23 of the Patents Act 1977 stops you from applying for a patent abroad without first getting written permission from the Patent Office unless an application has been filed at least 6 weeks beforehand in the United Kingdom for a patent for the same invention and either no direction prohibiting publication or communication has been given, or any such direction has been revoked.

Notes

a) *If you need help to fill in this form or you have any questions, please contact the Patent Office on 0645 500505.*

b) *Write your answers in capital letters using black ink or you may type them.*

c) *If there is not enough space for all the relevant details on any part of this form, please continue on a separate sheet of paper and write "see continuation sheet" in the relevant part(s). Any continuation sheet should be attached to this form.*

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ELECTRONIC CIRCUIT DEVICE

This invention relates to electronic circuit devices, and more particularly to the suppression of spurious unwanted emissions such as harmonic emissions from electronic circuit components and discontinuities.

Electronic circuits, and in particular microwave circuits, are used in a variety of applications, for example, they are commonly employed in motion detection units for detecting a moving person or object by means of a Doppler frequency shift.

All electronic circuits radiate spurious emissions which can exceed a maximum level set by current EMC regulations. In order to conform to current EMC standards, any spurious emissions outside the allocated frequency band from circuit components and discontinuities must be suppressed. In particular, circuit elements or devices such as dielectric resonator oscillators and mixers, which are used in motion detection units, can generate significant levels of harmonic emissions. These emissions can leak out through the mechanical joints between, for example, the enclosure and the circuit board of the microwave motion detection unit.

Circuits are therefore often housed in enclosures which act as shields to prevent unwanted emissions radiating into free space.

These enclosures are usually made of a conducting material such as aluminium or brass, or metal coated plastic. A conducting mesh can also be used provided the apertures in the mesh are small enough to prevent the emissions from escaping. Enclosures can also be made of an absorbing material to absorb the emissions. Alternatively, a plastic material loaded with metal filings or granules can be used to confine emissions to the enclosure.

High frequency emissions are more difficult to screen because they can escape through small gaps in the enclosure, for example, where the cover and the main enclosure joins, or at cable entry points.

Figure 1 shows a perspective view of a known motion detector 1. A frame 5 is used to clamp a printed circuit board 2 to the main enclosure 6. The circuit side of the printed circuit board faces inwards into the enclosure. The conducting groundplane of the printed circuit board is outward facing. A printed antenna is attached to the groundplane and is coupled to the circuit via a slot in the groundplane. Printed circuit board 2 has a solder tab 3. In order to accommodate solder tab 3, a slot is

cut into a side wall of frame 5 in order to allow the tab to pass through. A ribbon cable 9 is soldered to tab 3.

The gap between the circuit board 2 and one side of the slot in frame 5 is sealed by means of gasket 7 to block emissions. The gap between the circuit board and the other side of the slot has been minimised, but some clearance, gap 8, is necessary to prevent lines or components on the printed circuit board from being short circuited by either frame 5 or main enclosure 6. Gap 8 provides a path for unwanted emissions to radiate into free space.

In the present invention, an improved method of suppressing unwanted radiated emissions from an electronic circuit such as a microwave circuit and/or antenna circuit is provided wherein:

an enclosure for the circuit having a chamber for absorbing, reflecting and/or otherwise suppressing various emissions is provided about connection means extending from a circuit board, for example, a solder tab; and/or

an enclosure for the circuit is provided having an aperture sized and shaped to be a close fit about an item to be connected to the circuit board such as a cable.

In a first aspect, therefore, the present invention provides an electronic circuit device comprising:

an electronic circuit board having components and/or discontinuities capable of radiating unwanted emissions, the circuit having at least one connection means extending from a surface or a periphery of the board to which an external connection is to be made;

an enclosure for the circuit board, the enclosure comprising a first main portion and a second frame portion, the board being mounted there between, preferably, with a circuit groundplane outward facing;

at least one of the portions comprising means for substantially surrounding the upstanding connection means;

whereby unwanted emissions from the electronic components and/or discontinuities are substantially prevented from leaving the enclosure via a region adjacent to the connection means.

In a preferred embodiment, the first and second portions are adapted to provide a chamber about the connection means.

In a preferred embodiment, the second frame portion comprises an extension sized and shaped to substantially surround the upstanding connection means. Preferably, the extension is sized and shaped to clear the upstanding connection means. The extension may comprise an outwardly extending recess in a peripheral wall of the second frame portion. Preferably, the peripheral wall of

the frame, including the recess, is continuous. The frame may comprise electromagnetic radiation absorbing and/or reflecting material. Preferably, the frame is conducting.

In a further preferred embodiment, the first main portion comprises a projection extending from a wall of the main portion. Preferably, the projection on the first main portion and the extension on the second frame portion are sized and shaped to fit closely theretogether about the upstanding connection means.

Preferably, the projection of the first main portion comprises one or more apertures through which a connection to the connection means can be made. Preferably, the aperture is sized and shaped to accommodate a cable, antenna, power source or the like. The cable may be a ribbon cable. The connection means may be adapted for connection to the cable, antenna, power source or the like. The connection means may be a solder tab.

Preferably, the first main portion comprises electromagnetic radiation absorbing and/or reflecting material. Preferably, the first main portion is conducting.

The enclosure for the microwave circuit board is preferably conducting and can be constructed in metal, such as brass or aluminium, or be of a metal coated plastic. The enclosure could comprise a microwave absorbing material. A plastic material loaded with metal filings or granules could be used.

The enclosure can comprise a moulded cover, for example, of a metal loaded plastics material, the cover having an edge region conforming substantially to the edge of the microwave circuit board and being a close fit therewith. Any gaps between the peripheral edge of the microwave circuit board and the peripheral edge of the enclosure are minimised.

Microwave circuit components capable of radiating unwanted emissions include, for example, dielectric resonator oscillators, mixers and like components. Discontinuities in the printed or etched microwave circuit can also give rise to unwanted emissions.

In a further preferred embodiment, the circuit board is a printed circuit board.

In a further preferred embodiment, the device is a microwave circuit device.

A preferred embodiment of the invention will be described now, by way of example only, with reference to the following figures.

Figure 2 illustrates a perspective view of a frame for an electronic circuit device having an extension, seen from above.

Figure 3 illustrates the frame of figure 2, seen from below.

Figure 4 illustrates a perspective view of printed circuit boards, seen from above.

Figure 5 illustrates a perspective view of a main enclosure for an electronic circuit device, seen from above.

Figure 6 illustrates a perspective view of an electronic circuit device, in this case a motion detector assembly, when fully assembled, seen from below.

Referring now to figure 2, a frame 10 made of conducting material and having a continuous outer wall 10a is shown. Outer wall 10a comprises an extension 11.

Referring now to figure 3, it can be seen that extension 11 comprises a recess 12 for covering upstanding connection means in the form of solder tabs or the like (not shown).

Referring now to figure 4, a printed circuit board assembly generally indicated at 2, having a microwave circuit board 2c and having a solder tab 8 extending outwardly from the periphery of board 2c, is illustrated.

A printed antenna 2a is attached to the groundplane 2b of the printed circuit board 2c. The solder tab 8 is provided to allow external connections such as signal cables, power cables, antennae and other connections to be made to the circuit and components on board 2. Recess 12 in outer wall 10a of frame 10 is sized and shaped to substantially surround tab 8 without, in this preferred embodiment, touching it as this could cause a short circuit. Outer wall 10a is continuous ie no slots, or other gaps, are provided in the frame wall which could result in unwanted leakage of emissions.

Referring now to figure 5, a main enclosure portion 13 is shown. Printed circuit board 2 is mounted within space 14 in enclosure 13.

An outwardly extending projection 15 is provided in the wall of enclosure 13 at a location corresponding to

the location of solder tab 8 on circuit board 2. Projection 15 comprises aperture 16 sized and shaped to fit closely about the ribbon cable to be fixed to solder tab 8. When assembled, solder tab 8 is positioned adjacent upper surface 17 of projection 15.

Referring now to figure 6, an assembled electronic circuit for a motion detector is shown. Here, frame 10 and main enclosure portion 13 have been positioned about printed circuit board 2 (not shown) to provide an enclosure. The frame 10, main enclosure portion 13 and printed circuit board 2 have been aligned prior to assembly so that projection 15, extension 11 and solder tab 8 are aligned theretogether. As can be seen from the figure, projection 15 fits snugly within the opening of recess 12 such that extension 11 and projection 15 form a chamber within which solder tab 8 is located. The only access to solder tab 8 is now via aperture 16 through which a ribbon cable, for example, can be located. The cable is a close, push fit within the spaced circular holes which form aperture 16. The holes can be cylindrical or tapered to ease insertion of the cable.

The printed circuit board 2 with groundplane facing outwards, is mounted in the main enclosure 13 and held in place by frame 10. The frame and the main enclosure in the vicinity of the solder tab, ie projection 15 and extension 11, are a close fit to reduce emissions

escaping through the joint. The solder tab is now completely enclosed in a chamber formed by the frame and the main enclosure.

Although there is still a path through the cable insulator, ie the outer part of the ribbon cable, by which emissions can escape, the actual gap between the cable conductor, ie the central part of the cable, and the enclosure is smaller and hence unwanted emissions are reduced.

It will be apparent to those skilled in the art from the information contained herein that the principle of shaping the aperture in the wall of an enclosure to minimise gaps through which cables pass, can be applied to cables with different cross sections or to items other than cables, such as components, antennae and the like.

It will also be apparent to those skilled in the art that the preferred assembly is one in which a printed circuit board is mounted in an enclosure with the component side facing inwards. The printed circuit is held in place by a frame. The outer surface of the printed circuit is a conducting groundplane so that the component side of the circuit is completely surrounded and emissions are confined to the enclosure. A printed antenna is attached to the groundplane and coupling between circuits is achieved via a slot in the groundplane.

However, the invention can be applied to other mechanical arrangements. For example, the printed circuit board can be completely encased within a chamber consisting of a main enclosure and a separate cover. The assembly would not then be reliant on the circuit groundplane to act as a screen. Access to the circuit would be by a method similar to that used with the frame.

Indeed, the principle of providing an enclosure having a chamber, for absorbing, reflecting and/or otherwise suppressing emissions, about a connection means extending from a circuit board and/or providing an aperture sized and shaped to be a close fit about an item to be connected to the circuit board can be applied to other mechanical arrangements. All such alternative embodiments are intended to be within the scope of this application.

The reader's attention is directed to all papers and documents which are filed concurrently with or previous to this specification in connection with this application and which are open to public inspection with this specification, and the contents of all such papers and documents are incorporated herein by reference.

All of the features disclosed in this specification (including any accompanying claims, abstract and drawings), and/or all of the steps of any method or

process so disclosed, may be combined in any combination, except combinations where at least some of such features and/or steps are mutually exclusive.

Each feature disclosed in this specification (including any accompanying claims, abstract and drawings), may be replaced by alternative features serving the same, equivalent or similar purpose, unless expressly stated otherwise. Thus, unless expressly stated otherwise, each feature disclosed is one example only of a generic series of equivalent or similar features.

The invention is not restricted to the details of the foregoing embodiments. The invention extends to any novel one, or any novel combination, of the features disclosed in this specification (including any accompanying claims, abstract and drawings), or to any novel one, or any novel combination, of the steps of any method or process so disclosed.

CLAIMS

1. An electronic circuit device comprising:

an enclosure for an electronic circuit board, the enclosure having:

(i) a chamber for absorbing, reflecting and/or otherwise suppressing circuit emissions provided about a connection means extending from the board; and/or

(ii) an aperture sized and shaped to be a close fit about an item to be connected to the circuit board.

2. An electronic circuit device according to claim 1 comprising:

an electronic circuit board having components and/or discontinuities capable of radiating unwanted emissions, the circuit having at least one connection means extending from a surface or periphery of the board to which an external connection is to be made;

an enclosure for the circuit board the enclosure comprising a first main enclosure portion and a second frame portion, the board being mounted with groundplane facing outwards there between;

the first main enclosure portion and/or the second frame portion being adapted to provide a chamber about the upstanding connection means.

whereby unwanted emissions from the electronic components and/or discontinuities are substantially prevented from leaving the enclosure via a region adjacent to the connection means.

3. An electronic circuit device according to claim 1 or 2 comprising:

an electronic circuit board having components and/or discontinuities capable of radiating unwanted emissions, the circuit having at least one connection means to which an external connection is to be made;

an enclosure for the circuit board, the enclosure comprising the circuit groundplane a first main enclosure portion and a second frame portion, the board being mounted there between;

at least one of the first and second portions being provided with an aperture sized and shaped to be a close fit about a cable or other item to be connected to the connection means

whereby unwanted emissions from the circuit board are substantially prevented from leaving the enclosure via a region adjacent to the connection means.

4. An electronic circuit device according to any preceding claim wherein the second frame portion comprises an extension sized and shaped to substantially surround the connection means.

5. An electronic circuit device according to claim 4, wherein the extension is provided by a recess in a peripheral wall of the frame portion.

6. An electronic circuit device according to any preceding claim, in which the peripheral wall of the frame is continuous.

7. An electronic circuit device according to any preceding claim, in which the frame portion comprises electromagnetic radiation absorbing and/or reflecting material.

8. An electronic circuit device according to any preceding claim, in which the frame portion is conducting.

9. An electronic circuit device according to any preceding claim, in which the first main enclosure portion comprises a projection having one or more apertures through which connection to the connection means can be made.

10. An electronic circuit device according to claim 9, in which the one or more apertures are sized and shaped to be a close fit about a cable or other item to be connected to the connection means.

11. A circuit device according to any preceding claim, in which the first main enclosure portion comprises electromagnetic radiation absorbing and/or reflecting material.

12. A circuit device according to any preceding claim, in which the first main enclosure portion is conducting.

13. An electronic circuit device according to any preceding claim, in which the first main enclosure portion comprises a projection and the second frame portion comprises an extension, the projection and the extension being sized and shaped to be a close fit there together about the connection means of the circuit board.

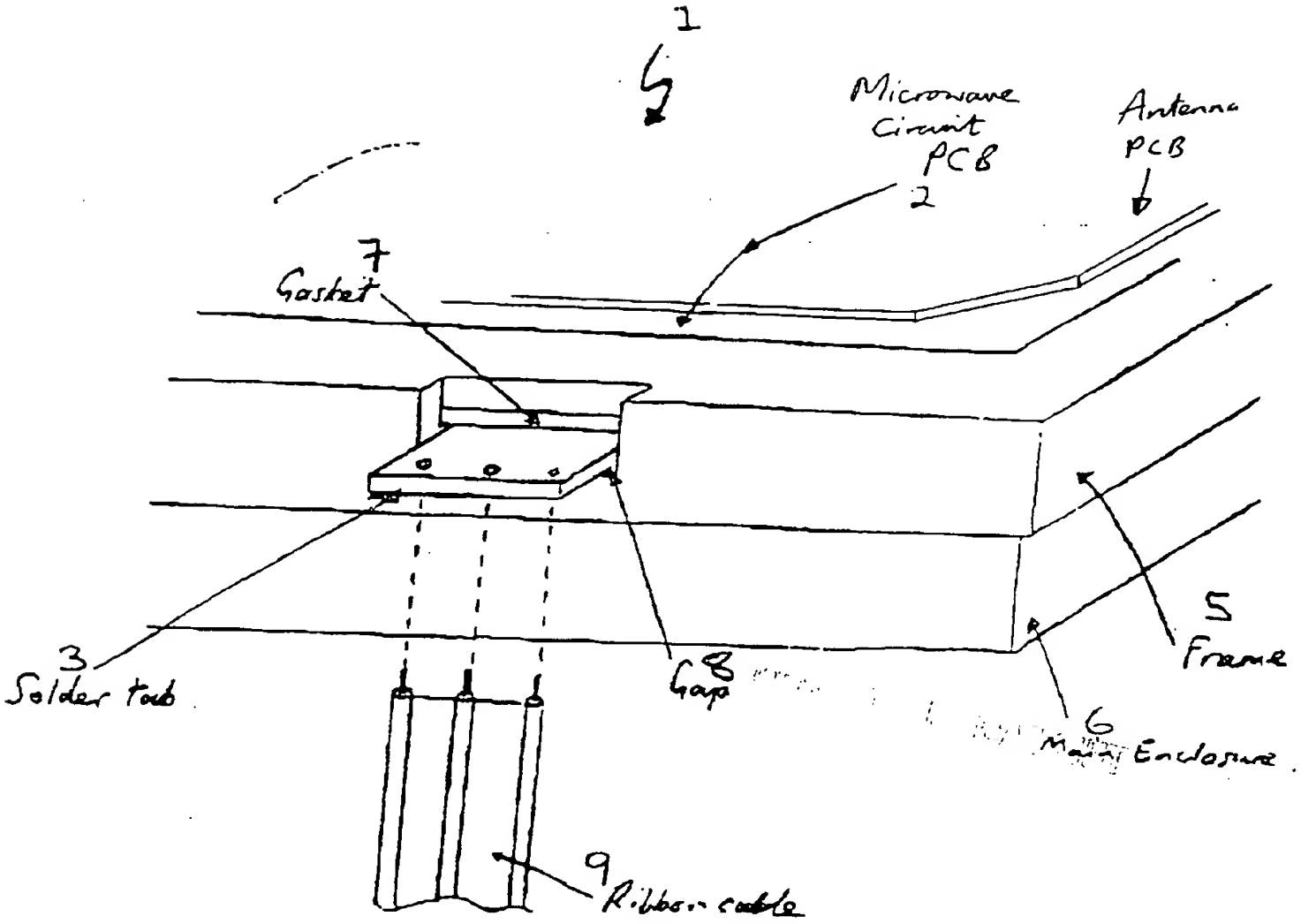

FIGURE 1 – PRIOR ART

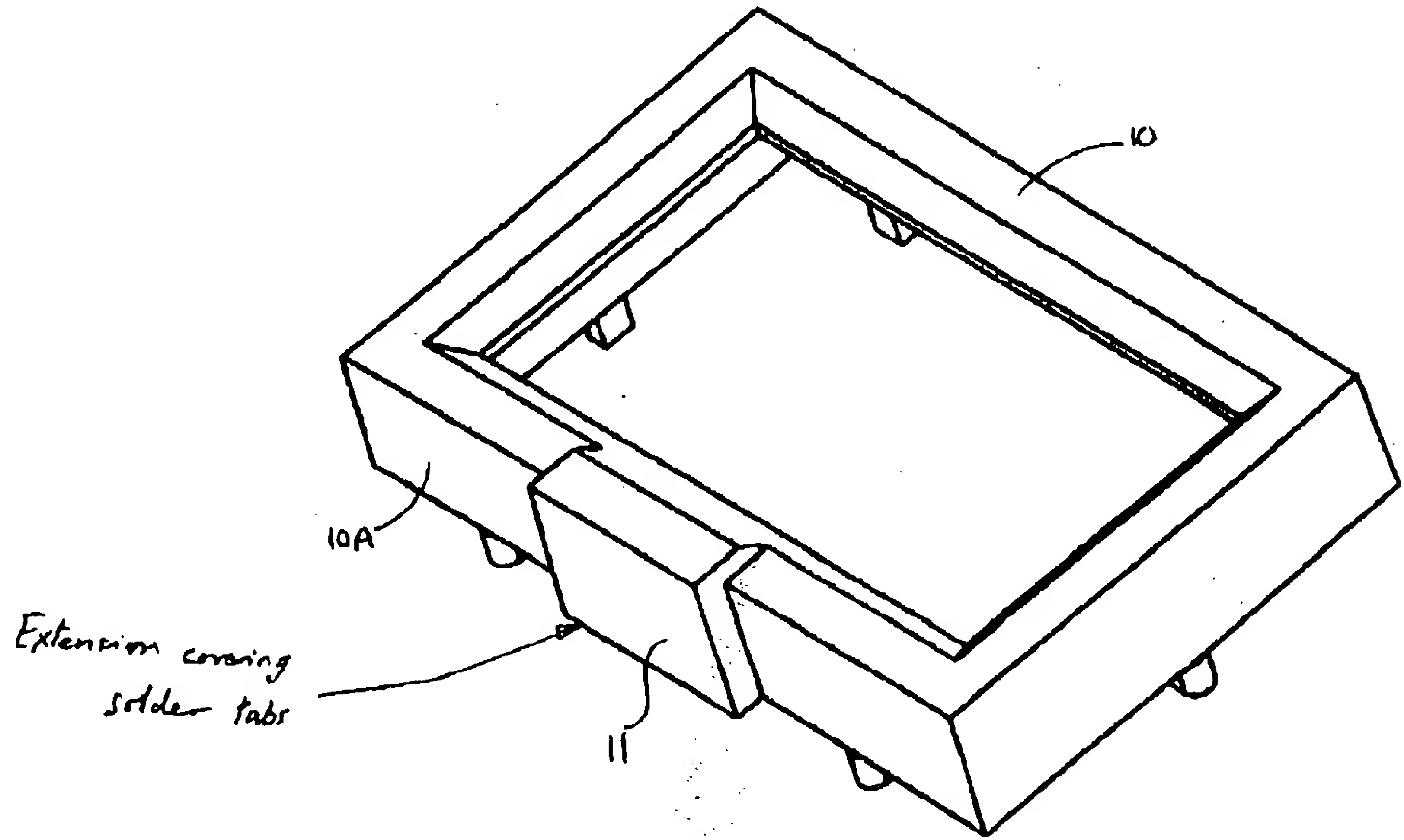

FIGURE 2 - FRAME

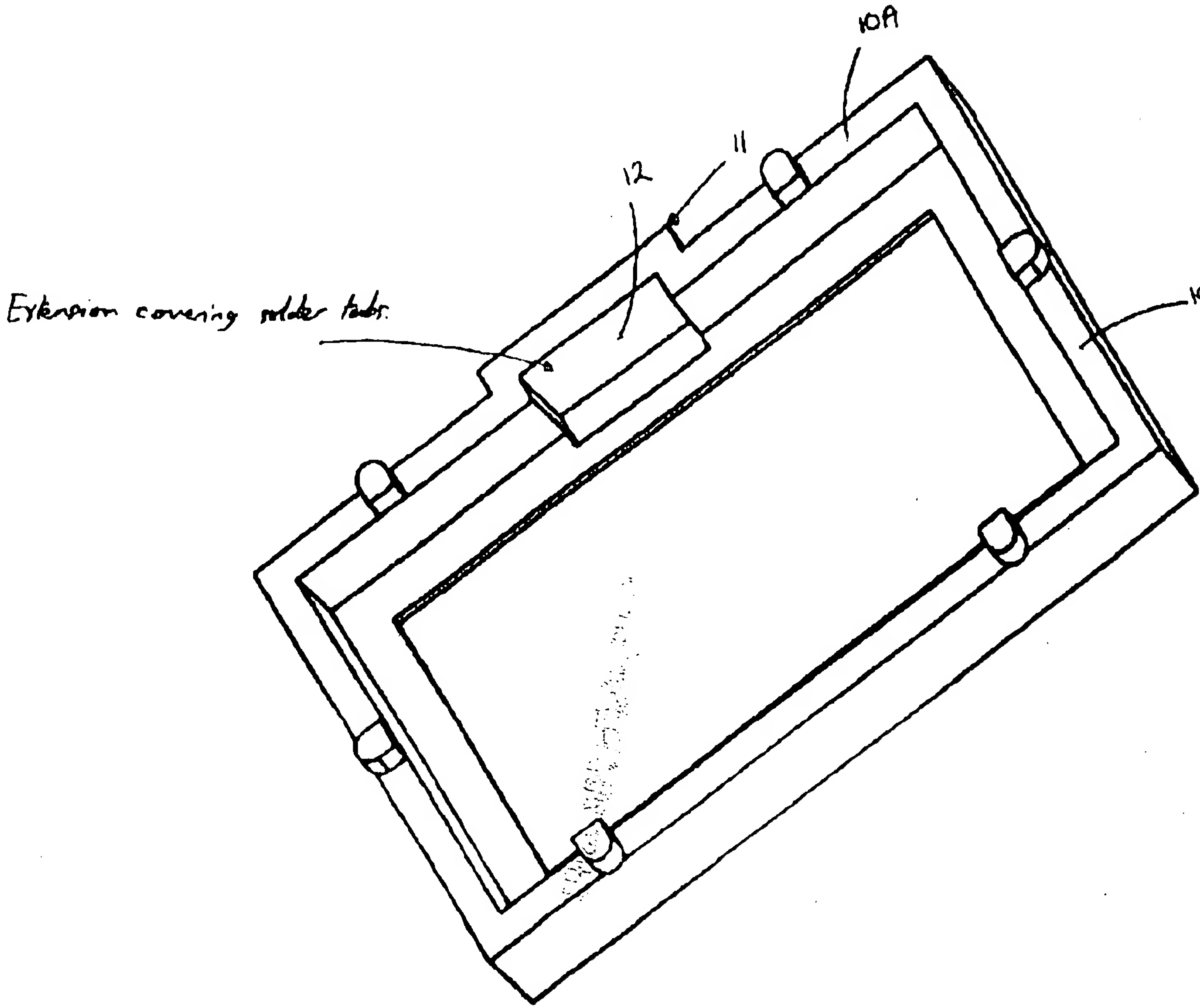

FIGURE 2

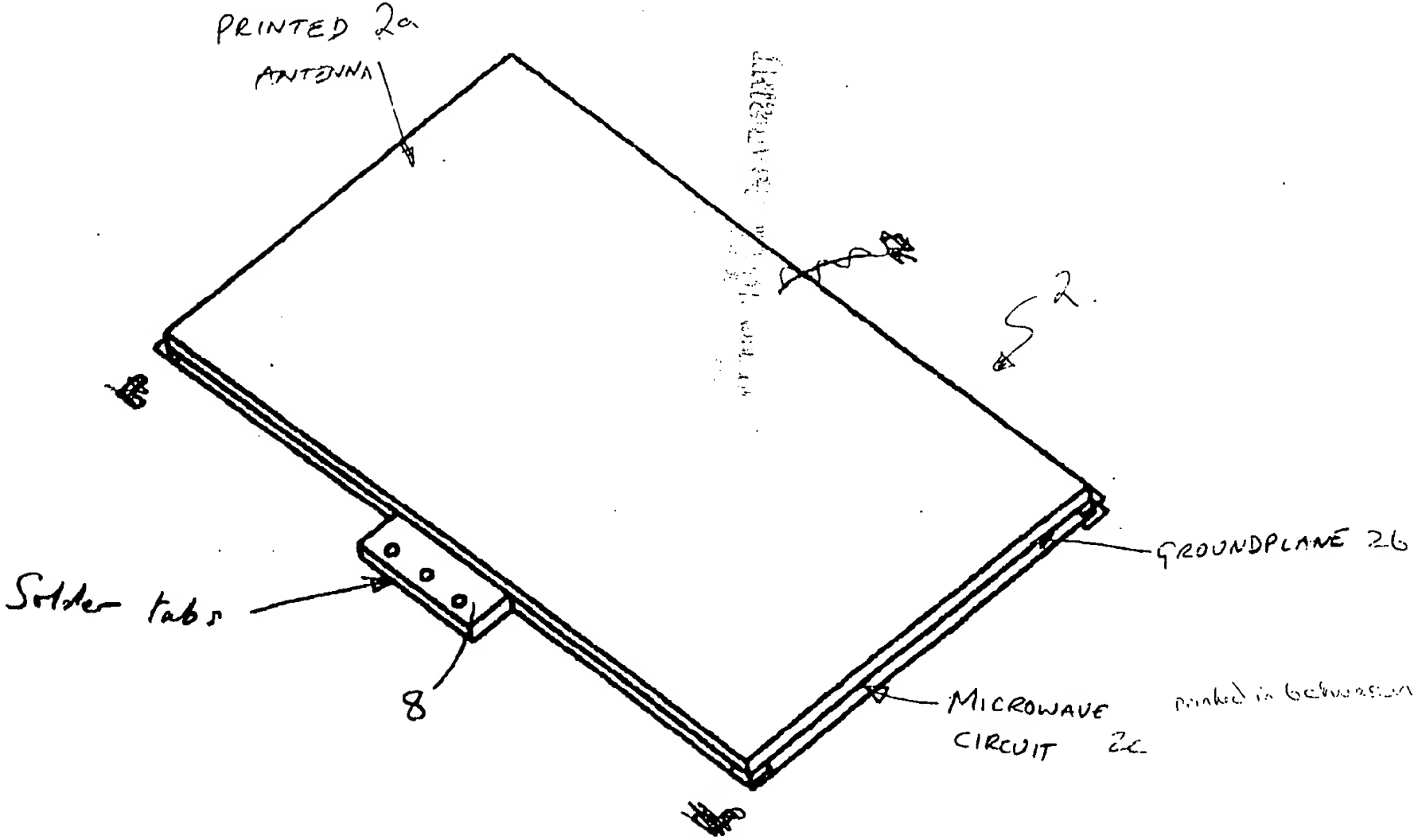

FIGURE #4 - PRINTED CIRCUIT BOARDS

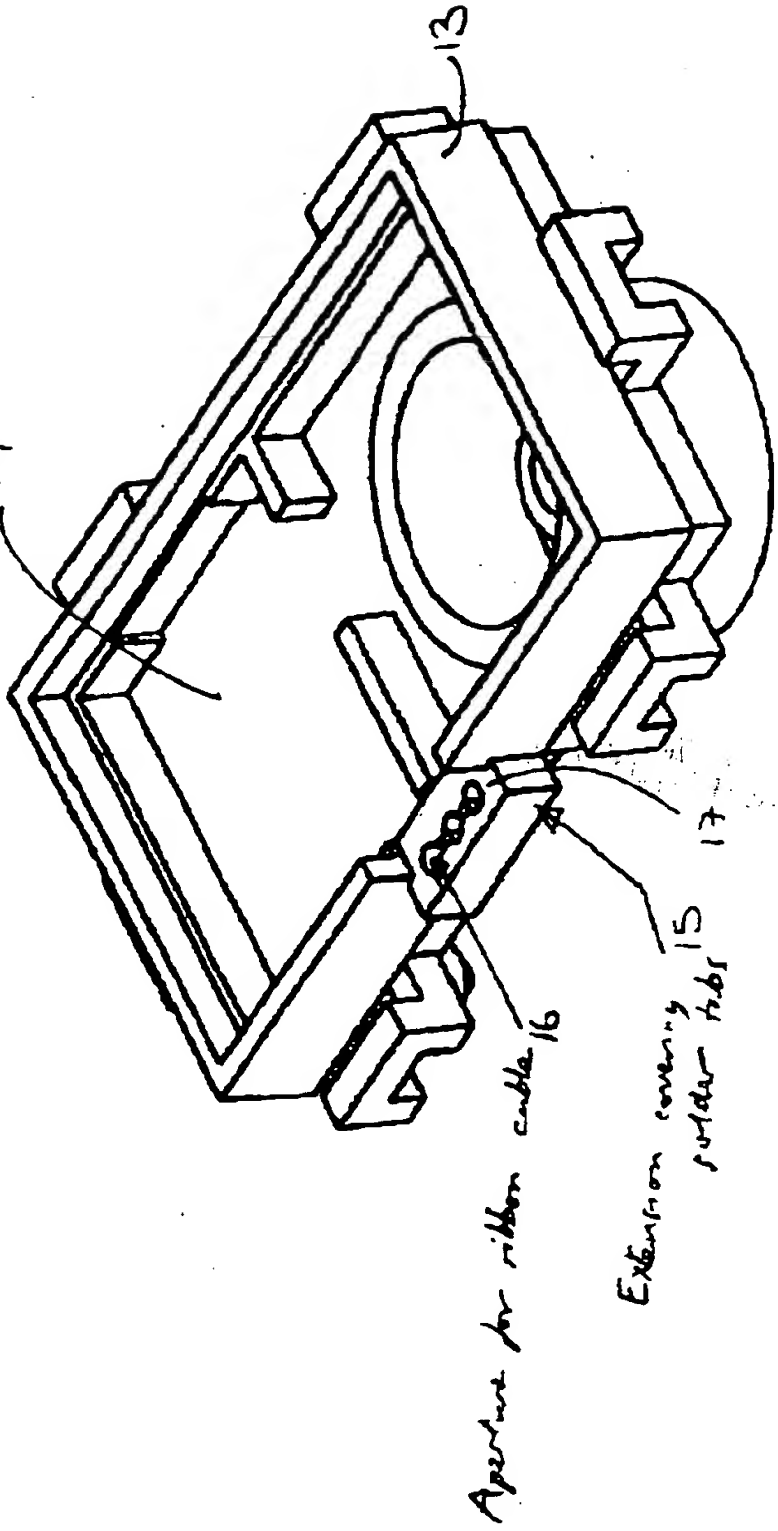

FIGURE #5 - MAIN ENCLOSURE

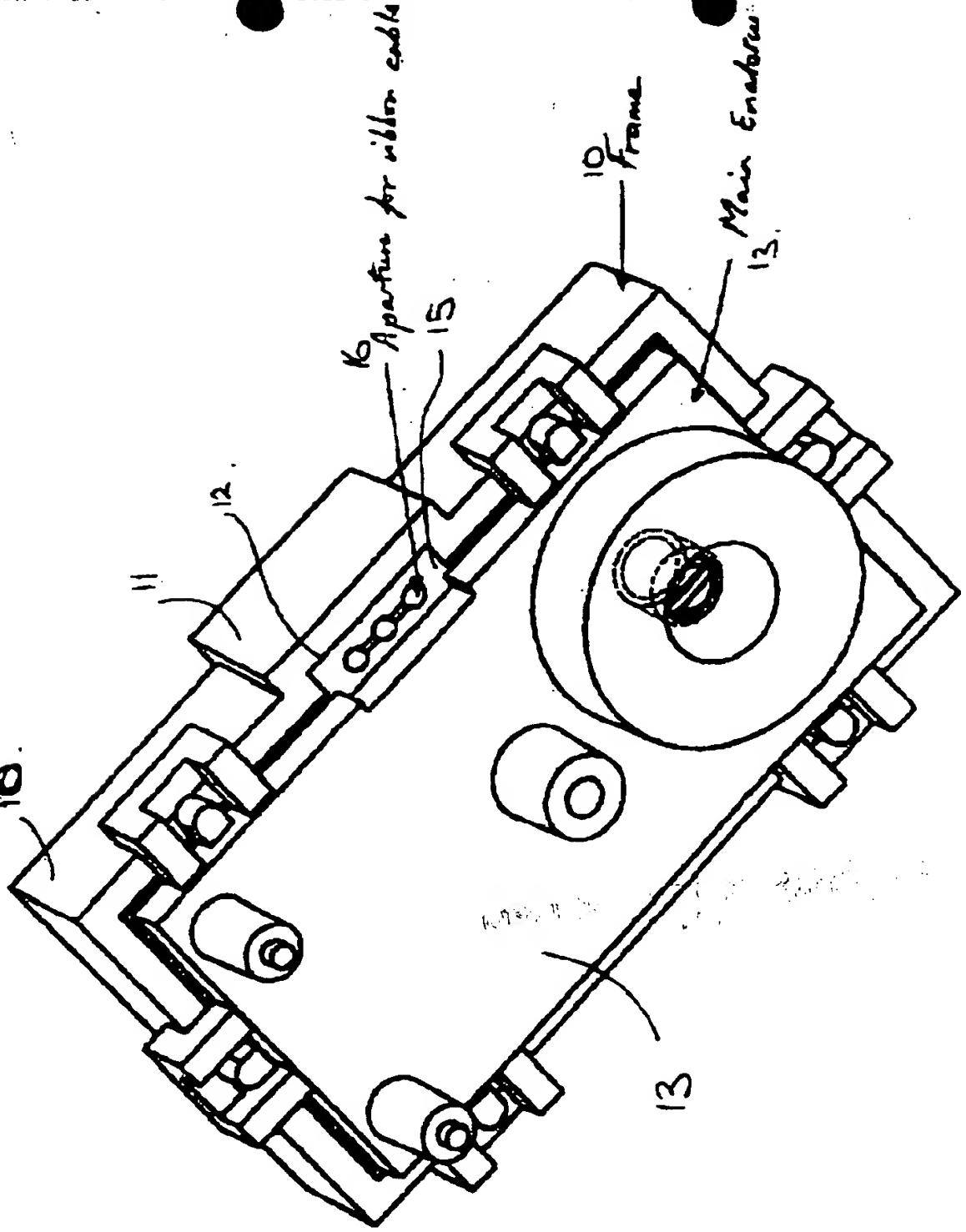

FIGURE 6 - MOTION DETECTOR ASSEMBLY